Final Report for Period: 06/2009 - 09/2009 **Submitted on:** 01/23/2010
Principal Investigator: El-Sayed, Mostafa A. **Award ID:** 0323617
Organization: GA Tech Res Corp - GIT
Submitted By:
El-Sayed, Mostafa - Principal Investigator

Title:
US-Egypt Cooperative Research: Surface Properties of Semiconductor and Metallic Nanocrystals

Project Participants

Senior Personnel

Name: El-Sayed, Mostafa
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Nigm, Soheir (Egypt)
Worked for more than 160 Hours: Yes
Contribution to Project:
She co-directed some of Dr Talaat students Research. She also gave several lectures on Photo Accoustic Spectroscopy to my students at Georgia Tech during het visits to Georgia Tech.
She was supported by The University of Benha in Egypt
She travelled to the USA couple of time during the support period.

Post-doc

Name: Quian, WEI (USA)
Worked for more than 160 Hours: Yes
Contribution to Project:
He operated the Femto-second Laser systems needed in some of these studies. He also explained to the Egyptian visitors our facilities during their visits.

Graduate Student

Name: Tabor, Chris(USA)
Worked for more than 160 Hours: Yes
Contribution to Project:
He made nano-particles by using Both Electron beam as well nano-sphere Lithography. He was supported by Chair funds as well as by other NSF-funds.
He also travelled to Egypt and gave presentation at an International meeting.

Name: Huang, Wenyu(USA)
Worked for more than 160 Hours: Yes
Contribution to Project:
He made nano-particles by using Electron beam Lithography. He was supported by Chair funds and NSF-DMR-funds.He also travelled to Egypt and gave presentation at an International meeting.He finished work for publication in international Journal

Name: Abdalla., Tarric (Egypt)
Worked for more than 160 Hours: Yes
Contribution to Project:
He operated and analyzed the results of the photo-Accoustic and the Raman instruments in the physics department at Ain-Shams U.

Name: Mohamed,, Mohamed(Egypt)

Worked for more than 160 Hours: Yes

Contribution to Project:

He operated and analyzed the results of the photo-Accoustic and the Raman instruments in the physics department at Ain-Shams U.

Undergraduate Student

Name: Givens, Rachel(USA)

Worked for more than 160 Hours: Yes

Contribution to Project:

She made Some nano-particles by using Electron beam Lithography.

Technician, Programmer

Other Participant

Name: Talaat, Hassan

Worked for more than 160 Hours: Yes

Contribution to Project:

co PI

Research Experience for Undergraduates

Organizational Partners

Ain shams u.

This is an international co-operative research with Dr Hassan Talaat Of the Physics Dept.Of Ain Shans U. In Cairo Egypt

Other Collaborators or Contacts

USA PARTICIPANTS:

DR WEI Quian ,
Postdoctoral fellow
Georgia Tech, Atlanta, Ga USA
Co-worker with Dr Talaat

Mr Chris Tabor
Graduate student

Ms Rachel Given
Was Undergraduate student and now is a graduate Student.

Mr Wenyu Huang
Graduate student

EGYPTION PARTICIPANTS:

CO PI: Professor Hassan Talaat, Physics Department

Ain Shams University, Cairo , Egypt..

, Dr Soheir Nigm,
Senior Researcher in Dr Talaat group
College of Engineering, Benha U.

Activities and Findings

Research and Education Activities: (See PDF version submitted by PI at the end of the report)

We have been able to synthesize monolayer array of gold nanocrystals by use of the nan-

spherelithographic and E-Beam techniques. These samples were given to Dr Talaat to Examine their Raman soectroscopy. We characterized it and determined its optical and photothermal properties.Mr Wenyu, a graduate student of mine, learnt a great deal about nanoscience working on this problem.
When Dr Hassan was at Tech, He gave couple of lectures on the solid stae research tht tis group was doing.I did the the same at ain Shams University.
Due to prblems involved in getting visas, this prgram has not progressed as fast as we were expected.We needed to extend the duration of the program which we did that was very beneficial.
Dr Talaat group is very involved with the applications of nanoparticles in the field of photo-accoustic and Raman spectroscopies with one of our x-graduate students, Dr Mona Mohammed , who has received her PhD wit me and is now an active researcher in Egypt. is now supplying a large number of nano-technology scientists in Egypt , including Dr Talaat's group, with Nano-Particles.

One of my students ,Wynu Huang AND I WENT TO EGYPT TO give talks at a meeting organized by Dr Talaat and interacted well with his group.
Talaat and his collaborator and X-student, Professor Soheir Goneim came to Georgia Tech several times and Gave excellent and educational Seminars about Raman and Photo-Accoustic Spectroscopy and interacted with my group and we dicussed a paper we were writing together which we latter published.They were given a tour of our electron beam facilitie and my students prepared new samples of nanogold for them.

Findings:

We found that absorption probability of the surface plasmon transition in the prismatic shape to be 6-8 orders of magnitude larger than that of the spherical shape. This can be useful in photonic applications.
We have found that surface enhanced Raman is very sensetive to shape, in agreement with theoretical predictions.We are now tring to quantify this observation.
The photothermal property of (Ag and Au) plasmonic nanoparticles has brought about many important discoveries and applications in nanoscience and nanotechnology. In this review, we briefly summarize a photothermal effect, the coherent phonon oscillation, of plasmonic nanoparticles irradiated with ultrafast laser pulses of low power density. The coherent phonon oscillation is created in the nanoparticle by the ultrafast impulsive photothermal heating. The effects of size, shape, thickness, and interparticle interaction on the period of coherent phonon oscillations are discussed. The detection of the coherent lattice oscillation of metallic nanoparticles provides a powerful tool to characterize the mechanical and structural properties of nanostructures.
Talaat and el-Sayed published a joint paper in Chem Phys. Lett, a highly regarded in our research field.In this paper,the results of a combination of optical and scanning tunneling

microscopy (STM) has determined that at room temperature, the band gap of CdSe quantum rods (QRs) depends mainly on the width (thr dimension of electron confinement) and slightly on the length of the rods, in confirmation with previous studies that were carried out at low (liquid Helium) temperature. These results have a lot of importance to nanotechnology. These results have also shown that the theoretical models, the effective mass aproxmation (EMA), and the semi-imperical pseudopotential method (SEPM) are both in agreement with the expermintal results within 0.08 e V (room temperature energy is 0.025 eV)

Training and Development:

Teaching graduate students the field of Nanoscience reseach is good for both the USA and Egypt.Exchange is good for training our students to be global in their interactions in a world in which industry and economy are getting to be very Global.
Elsayed visited Ain Shams U, gave several seminars and discussed research with the active group of Dr Talaat.
Professor El-Sayed and one of his best students, gave talks at an international meeting organized by Professor Talaat in Cairo and sponsered by NSF.During this meeting,we interacted well with Dr Talaat and his group. We also gave them samples for their studies.
The results of a combination optical and scanning tunneling microscopic (STM) studies determined at room temperature, showed that the band gap of CdSe quantum rods (QRs) depends mainly on the width (thrdegree of electron confinement) and slightly on the length of the rods, in confirmation with previous studies that were carried out at low (liquid Helium) temperature. These results have a lot of importance to nanotechnology. These results have also shown that the theoretical models, the effective mass aproxmation (EMA), and the semi-imperical pseudopotential method (SEPM) are both in agreement with the expermintal results within 0.08 eV (room temperature energy is 0.025 eV).

Outreach Activities:

We have been in contact with our Egyption collaborators to whom we have been sending them these arrays for use in the Raman and photo-accoustic experiments.
The whole program is based on out reseach across ocean and national boundries. My student and I went and gave talks and interacted with the Egytion students in Egypt.Dr Talaat visited and his collaborators visited our Lab and interacted with our students, both scientifically and culturally.

Journal Publications

W. Huang and M.A. El-Sayed, "Photothermally excited coherent lattice phonon", Eur. Phys. J. Special Topics,, p. 325, vol. 153, (2008). Published,

W. Huang and M.A. El-Sayed, "Pulsed laser photothermal annealing and ablation", Eur. Phys. J. Special Topics, p. 223, vol. 153, (2008). Published,

T.A. El-Brolossy, T. Abdallah , Mona B. Mohamed, S.Abdallah, , K. Easawi , S. Negm and H. Talaat, "Shape and size dependence of the surface plasmon resonance of gold nanoparticles studied by Photoacoustic technique", European Physical Journal ST, p. 361, vol. 153, (2008). Published,

T.A. El- Brolossy, S. Abdallah, T. Abdallah, Mona B. Mohamed, S. Negm and H. Talaat ,s, "Photoacoustic characterization of optical and thermal properties of CdSe quantum dot", European Physical Journal ST, p. 365, vol. 153, (2008). Published,

T.A. El- Brolossy, S. Abdallah, T. Abdallah, H. Awad, S. Negm and H. Talaat, "Photoacoustic spectroscopy characterization of CdSe quantum rods", , European Physical Journal ST, p. 369, vol. 153, (2008). Published,

H Talaat,T. Abdallah, M. b. Mohamed, S. Negm, M. A. El-Sayed, "The sensitivity of the energy band gap to changes in the dimensions of CdSe quantum rods at room temperature: STM and theoretical studies.", Chemical Physics Letters., p. 288-, vol. 473, (2009). Published, 292

Books or Other One-time Publications

Web/Internet Site

Other Specific Products

Contributions

Contributions within Discipline:

The use of nanoparticles in the field of photothermal and photoaccoustic speectroscopy is indeed a new advance and will grow rapidly.The Elsayed group has contriuted to the field of the photothermal properties of gold nanoparticles. The Talaat group is advancing the use of Gold Nanoparticles in the field of Photo-Accoustic Spectroscopy.

Contributions to Other Disciplines:

Extending the phtothermal properties of gold nanoparticles studied greatly by El-sayed group to the field of photoaccoustic spectroscopy by the Talaats group, is indeed a fresh application in nanotechnology.The potential applications of photothermal properties to cancer therapy and photoaccoustic in enhanced immaging for diognostics in medical applications are clear oucome of these sudies.

Contributions to Human Resource Development:

A number of the Talaat group have become nanotechnologists and got fellowships in the US, Europe and Japan to get their Ph D.One of thePhD students of El-Sayed, Dr Mona Mohammed Bakr is now leading a large group in Nanotechnology in Cairo University interacting with many groups in Egypt in the field of NanoTechnology.

Contributions to Resources for Research and Education:

Extending nanotech to one of the most active research lab in Egypt(that of Professr Talaat) is extending important field of education to broad comunities Worldwide.

Contributions Beyond Science and Engineering:

The interaction of my students with Dr Talaat and my interaction with his students in my frequent visits on an individual and cultural basis is very important in helping establishing peace in this region.Going to Egypt, El-Sayed gave several TV appearances to help induce the private sector and the government to invest in nanotechnology.

Conference Proceedings

Categories for which nothing is reported:

Any Book

Any Web/Internet Site

Any Product

Any Conference

Summary of Exchange Visits During the whole program

El-sayed went to Egypt four times during the support period. Once was with his graduate student Chris Tabor and once was with the other graduate student. Wenyu Huang. In the visits with the students, we also made presentations and attended international meetings that were organized in Egypt at the visitation period.

Talaat came to the USA three times during the support period, two of these visits he came with his senior collaberator, Dr Soheir Nigm

During these exchange visits, Seminars were given to the full home groups and discussions of the techniques and results of each group are made, the samples of the gold nanoparticles made by the electron beam lithography by the GT group were given to the Egyptian participants (they are too fragile to be delivered by any other means) and papers are discussed and are written.